DICTIONARY OF

# APPLIED MATH FOR ENGINEERS AND SCIENTISTS

**Library of Congress Cataloging-in-Publication Data**

Dictionary of applied math for engineers and scientists/ edited by Emma Previato.
p. cm.
ISBN 1-58488-053-8
1. Mathematics—Dictionaries. I. Previato, Emma.

QA5 .D49835 2002
510'.3—dc21 2002074025


International Standard Book Number 1-58488-053-8
Library of Congress Card Number 2002074025
Printed in the United States of America 1 2 3 4 5 6 7 8 9 0
Printed on acid-free paper

**simplicial subdivision** Given a simplex, $S$, its *simplicial subdivision* is a collection of simplices, say $\{T_i\}$ such that $\vee_i\{T_i\} = S$ and for any $i$ and $j$, either the intersection $T_i \wedge T_j$ is empty or equals the closure of a common face. The *mesh* of the subdivision is the diameter of the largest subsimplex. This arises in a fixed point approach to compute an economic equilibrium.

**simulated annealing** An *algorithm* for solving hard problems, notably combinatorial optimization, based on the metaphor of how annealing works: *reach a minimum energy state upon cooling a substance, but not too quickly in order to avoid reaching an undesirable final state.* As a heuristic search, it allows a non-improving move to a *neighbor* with a probability that decreases over time. The rate of this decrease is determined by the *cooling schedule*, often just a parameter used in an exponential decay (in keeping with the thermodynamic metaphor). With some (mild) assumptions about the cooling schedule, this will converge in probability to a global optimum.

**sine** The function

$$\sin(x) = \frac{e^{ix} - e^{-ix}}{2i}$$

Geometrically, it is the ratio of the lengths of opposite side to hypotenuse of a right triangle with an angle $x$, for $0 < x < \frac{\pi}{2}$.

**singleton node** A node of degree one. Synonymous with *pendant node.*

**sinistralateral** The set of obligatorily coreacting species arbitrarily written on the left-hand side of a formal reaction equation.

*Comment:* See *dextralateral* for explanatory comments. See also *direction, dynamic equilibrium, formal reaction equation, microscopic reversibility, product, rate constant, reversibility*, and *substrate.*

**skew symmetric matrix ($A$)** $A$ is square and $A' = -A$.

**slack variable** In an inequality constraint of the form $g(x) \leq b$, the slack is $b - g(x)$, which is designated by the slack variable, $s$. Then, the original constraint is equivalent to the defining equation, $g(x) + s = b$, plus $s \geq 0$.

**Slater's (interiority) condition** Originally for the purely inequality system with $g$ convex, it means there exists $x$ for which $g(x) < 0$. More generally, for a mathematical program in standard form, it means there exists $x$ in $X$ for which $g(x) < 0$ and $h(x) = 0$.

**slope** Of a nonvertical straight line with equation $y = mx + b$ is by definition the number $m$.

**smetic state** See *liquid-crystal transitions* and *mesomorphic phase.*

**smooth** Referring to a continuously differentiable function.

**solitons** There are types of wave equations called *soliton type equations* that admit special *solitary wave solutions* called *solitons.* These *solitons* have the following property: suppose two *solitons* are moving left to right, well separated with the smaller one to the right. After some time the bigger one catches up, the waves overlap and interact. Still later the bigger wave separates from the smaller one, and eventually regains its initial shape and velocity. The only effect of the interaction is a phase shift.

Example: The *Korteweg-deVries* equation has *solitons* of the form

$u = 2k^2 sech^2 k(x - 4k^2 t - x_0)$, $k, x_0$ constants.

**spanning tree (problem)** A subgraph that is a tree containing all nodes. The *max weight spanning tree problem* is to find a *spanning tree* such that the sum of (given, positive) weights of the *edges* is a maximum.

The max spanning tree problem is solvable by the following greedy algorithm:

Input. Connected graph with weights, $w_1 \geq \ldots \geq w_m$.

Output. Maximum weight spanning tree, $T$.

(i.) *Initialization:* Set $k = 1$; $T$ = graph with given nodes and no edges.

(ii.) *Iteration* (until $k = m - 1$): Test if the $k$th edge forms a cycle with $T$. If not, add it to $T$; if so, discard the edge. In either case, increment $k$ and iterate.